能登臨海実験所年報　第8巻
Ann. Rep. Noto Mar. Lab.
Vol. 8. March 1968, pp. 15-18

On a Hermaphroditic Specimen of the Sea-star, *Certonardoa semiregularis* (MÜLLER et TROSCHEL)

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In Asteroids the hermaphroditic specimens of normally dioecious species are sometimes reported. A specimen of *Asterias rubens* was reported by RETZIUS (1911), a similar case of *Marthasterias glacialis* by BUCHNER (1911) and *Leptasterias groenlandica* by LIEBERKIND (1920), in which the gonads are partly male and partly female.

The writer also examined a similar hermaphroditic specimen of *Certonardoa semiregularis* which is one of the common sea-stars in Japan. It was obtained from Ogi in the vicinity of the Noto Marine Biological Laboratory Kanazawa University in May, 1962. It measures 65 mm in R. He will report here on it.

Comparing with the other specimens of the species, the present specimen is not peculiar in external features. In the species the sexes are normally separate and can not be distinguished externally. It has branched lobular gonads arranged in longitudinal series along each the lateral side of the arm. The colour of the gonads differs in sex, the testes are yellowish orange, the ovaries scarlet, and the latter much swollen. It is, therefore, easy to distinguish the sexes from the colour and form. In the specimen examined, the ten series of the gonads are all male, but one of which is partly female. The ovaries are found at the arm base, consisting of two gonads in the series and show a sharp contrast with the rest. They contain large and yolky eggs visible to the naked eye through the ovarian membrane.

The ovary was sectioned, which was fixed by Bouin's fluid. It is covered externally with a flat peritoneum. The nuclei are round and separated with each other. The ciliation of the epithelium could not be ascertained. Under the epithelium is a thin layer of fibrous connective tissue, the nuclei of which are slightly oval in form, very slightly larger than those of the epithelium. Among them are scattered elongated dark nuclei. These are the nuclei of muscle fibers. The fibrous layer is split into two layers by a narrow space, genital sinus. The outer layer is generally slightly thinner than the inner underlain by germinal epithelium.

The ovary contains many oogonia and primary oocytes of various stages and the follicular cells. The oocytes are each invested with a very thin layer of small follicular cells. The oogonia of the very early stages are exceedingly small, hardly distinguishable from the follicular cells which fill the interspaces among the ova. When the nuclei of the cells grow to 2 to 5 microns in diameter, the cytoplasmic body is found around the nucleus. These nuclei are slightly larger than those of the follicular cells, in which the nuclei measure about 1 micron. When the ova measure about 17 to 20 microns in the long axis, the characteristic nhcleolus appears. In the larger ova,

the nucleoli are very distinct, placed eccentrically, in which oil-drop-like structure is found. The nuclei of the ova, germinal vesicles, are generally situated near the center and the yolk granules uniformly distributed through the cytoplasm. The measurements of the ova are as follows :

Diameter of ova (microns)	Diameter of nuclei (microns)
6.6	3.5
13 × 10	5
16.5× 10	6.5
60 × 32	23
80 × 40	33 × 13
89 × 73	26
105 × 73	53 × 33
133 × 80	40
173 × 93	46
200 × 13	53
226 × 120	53
239 × 226	66 × 40
240 × 133	66 × 53
253 × 173	66 × 53
266 × 133	80 × 40
319 × 226	93 × 66
600 × 532	120
640 × 448	128
665 × 532	146 × 106
672 × 480	160 × 96

As listed above, the ova become very large, the large ones measuring 0.6mm or more. The small ones probably may not be discharged in the season. Having such large yolky eggs, the development of the present species might be direct as in the sea-stars, *Asterina*, *Henricia* and *Leptasterias*, in which the eggs are large and yolky.

In the closer examination, the writer found the testes in the two small lobes of the ovary. The gonad, therefore, was a case of sexual mosaic, though it has a quite ovarian appearance. The testes seem to be normal, not containing any ovum, though OHSHIMA ('25, '29) reports there the young oocytes of various stages in *Asterina batheri*.

The wall of the testis is similar to that of the ovary. The germinal epithelium is thick, consisted of two sorts of germ cells with round nuclei, the one larger than the other. Judging from the figures of the cell division, the large ones are the primary spermatocytes and the smaller the secondaries. The writer could not ascertain the spermatogonia among these cells. It is supposed that the stage of the testis here examined might be late to find them. Both the spermatocytes are mixed, and the primary spermatocytes are not restricted in the basal portion of germinal epithelium, though being more numerous there. These cells have a tendency to arrange in series

toward the central lumen. In the lumen are found a group of small cells which are isolated spermatocytes and the spermatids. The spermatids are about half as large as the secondary spermatocytes.

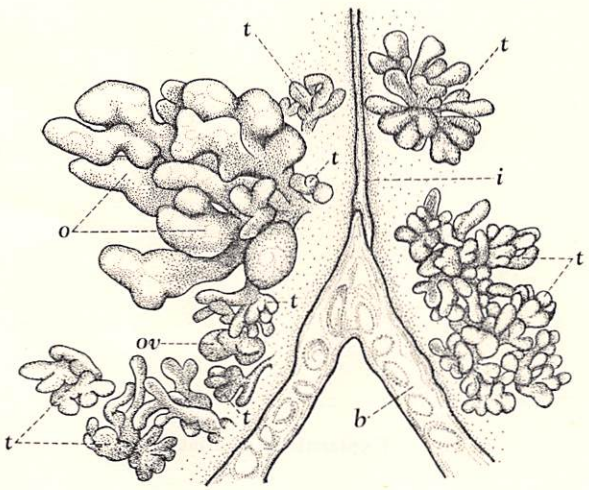

Fig. 1. *Certonardoa semiregularis*; a portion of gonads in an interradius, viewed from coelomic side. 5 X.
b the cut surface of body wall, i interradial septum, o ovary, ov ovary, a greater part of which cut off, t testis.

In the testis, a month later, the secondary spermatocytes are uniform in size and form and arranged in regular series forming columns. The primary spermatocytes are large, about twice as large as the secondaries, situated only in the basal portion of the epithelium, and the spermatids and spermatozoa are found in the lumen.

As already stated above, it is no doubt that the gonad here examined is a case of sexual mosaic, and both the ovary and testis seem to be normal. He examined lately a large number of the specimens of the species obtained from Himi, Toyama Bay. So far as his examination goes, the present species seems to be distinct in sex. Therefore, he doubts if it is a representative of the protandric hermaphrodite, until a further investigation is done.

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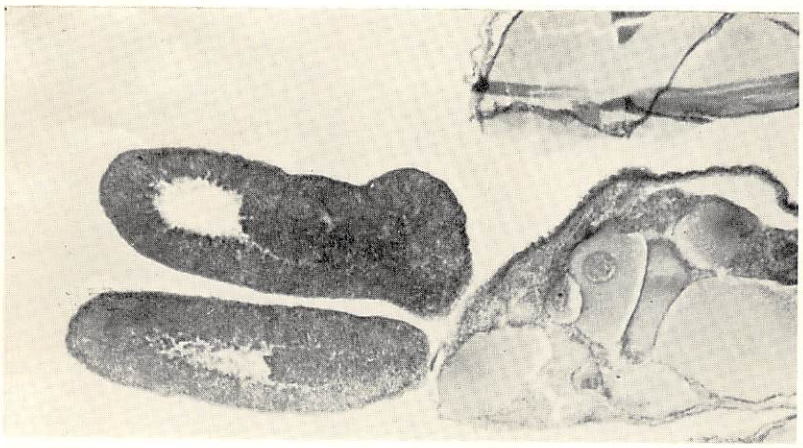
Explanation of Plate I

Fig. 1. The hermaphroditic gonad of *Certonardoa semiregularis*. 60 X.

Fig. 2. The testis of normal specimen of the same species, amonth later than in Figs. 1 and 3. 250 X.

Fig. 3. The testis of the hermaphroditic specimen of the same species. 300 X.



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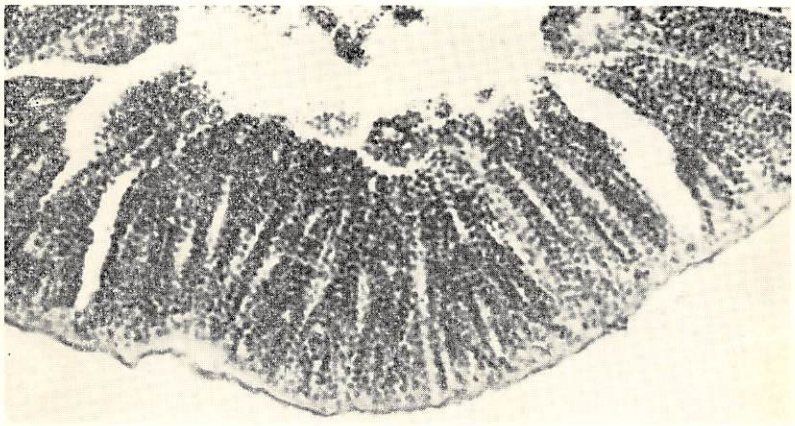

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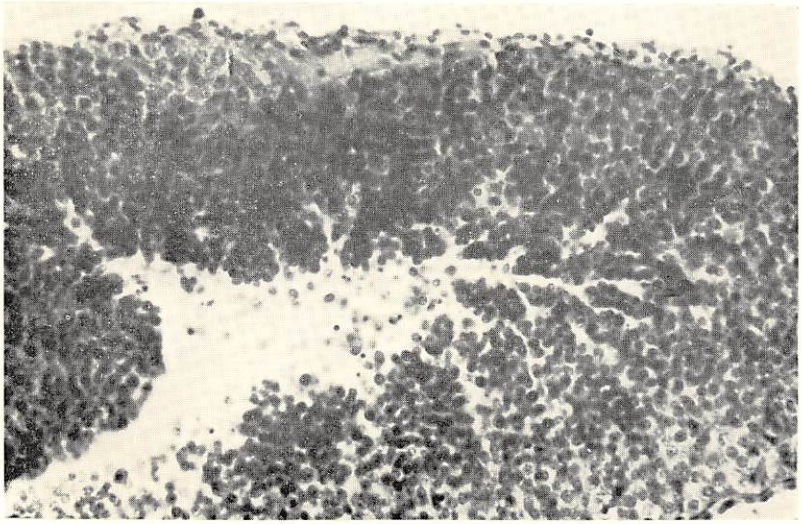

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